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ABSTRACT

Three research questions were posed for a study: (1) Are there differences among the Piagetian scores of students in the various teaching majors? (2) Do students at various cognitive levels differ in academic achievement? and (3) Do students in different teaching majors differ in achievement? The population included 670 education students enrolled in a course in developmental psychology. Of these, 33 were early childhood majors, 276 were elementary education majors, 188 were secondary education majors, and 168 were K-12 certification majors (i.e., music, art, and physical education). The remaining five had not declared a major. A written test requiring the use of syllogisms, verbal analogies, proportional reasoning, and hypothetical reasoning determined the students' cognitive levels--concrete operations, transition between concrete and formal, and formal. Findings revealed that secondary education majors had significantly higher cognitive levels than did early childhood, elementary, and K-12 majors. These findings are analyzed, and it is suggested that grouping students by major may help them learn more effectively than grouping them in sections where all majors are represented. (JD)

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Achievement in Foundations Courses
Related to Cognitive Level or Major?

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Achievement: Cognitive Level or Major?

Abstract

This study was to determine whether academic achievement differed according to Piagetian cognitive level and/or teaching major of college students. The results indicated that Piagetian scores differed according to the students' teacher education major and that achievement differed according to the students' Piagetian level and teaching major.

Achievement in Foundations Courses: Related to Cognitive Level or Major?

Professional educators, particularly those who are involved in teaching foundation courses such as developmental or educational psychology are often faced with students who vary not only in degree of interest in the course but also in terms of ability to complete requirements. One could ask whether foundations courses should be taught to homogeneous or heterogeneous groups in terms of cognitive development as explained by Piaget. Differences in cognitive level may account for the fact that some students are able to define a term but not able to apply that knowledge in their public school practicum or that one student grasps a theory while another does not understand it after lengthy discussion.

Research results on the cognitive level of college students has been mixed. Piaget (1972) reported that formal operations emerged between 12 and 15 years of age. However, research by Dale (1970), Tishner (1971), Kincheloe (1972), Ball and Sayre (1972) and Karplus and Peterson (1970) indicated that formal thought may not be attained until 15 to 20 years of age. Some researchers reported that college freshmen often have not attained all the characteristics of formal thought (Schwebel, 1975; Lovell, 1961; McKinnon, 1970: McKinnon and Renner, 1971). An education professor might therefore find a student who because of the student's cognitive level is able to learn basic

facts from the textbook, but not be able to apply those facts when working with students.

Cognitive level may also be related to the teacher education major a student may choose. A student, who in high school was a high achiever in science, mathematics, history or English because of a higher cognitive level of thinking, might ont to major in secondary teaching. On the other hand, a student who had had little success with subjects requiring formal thought may select early childhood, elementary or education majors which are not dominated by higher cognitive processes (such as K-12 majors like P.E. or art).

If these differences in cognitive level are related to a student's choice of teacher education major, achievements may also differ according to major. If this is true, there may be justification for developing alternative methods or programs to accommodate these differences. This study was undertaken to determine if academic achievement differed according to Piagetian cognitive level and/or major of college students.

The research questions for the study included the following:

1) Are there differences among the Piagetian scores of the various teaching majors?
2) Do students at various cognitive levels differ in academic achievement?
3) Do students in different teaching majors differ in achievement?

Method

The population for this study included all 670 students enrolled in a beginning education course (developmental psychology) at an Iowa university. Of these students, 33 were early childhood majors, 276 were elementary majors, 188 were secondary majors, and 168 were K-12 certification majors (i.e., music, art and physical education). The remaining five students had not declared a major. Of this population, 25 percent were male and 75 percent female. The achievement score was a total accumulation of points from 1) quizzes which required knowledge of developmental concepts, 2) projects in which students applied their knowledge base to an individual encountered in their practicum in a private or public school, and 3) unit tests which required application, comparison, and thorough analysis of the relationship among various concepts. These categories parallel those described in Bloom's Taxonomy of Educational Objectives (1956).

Cognitive level of students involved in the study was determined by a written group instrument including 21 items which required the use of syllogisms, verbal analogies, proportional reasoning, and hypothetical reasoning (Burney, 1974). On this basis, the student's cognitive level was categorized into three stages: 1) concrete operations--score of 0-7, 2) transition between concrete and formal--score of 8-13, and 3) formal operations--score of 14-21. Statistical procedures

included the use of analysis of variance and chi square to determine significant differences.

Results

A one-way analysis of variance indicated that Piagetian scores differed according to the students' teacher education major, F (3,661) = 10.89, $p < .001$, with secondary majors having significantly higher scores than early childhood, elementary and K-12 majors. See Table 1 for means and standard deviations of Piagetian scores by major. To further explore this difference, a chi square was done utilizing the three Piagetian groups and four majors. This resulted in a chi square of 15.40 (6 df) with a significance at the .05 level.

A series of one-way analysis of variance tests indicated that quizzes, projects, unit tests, and total achievement differed according to the students' Piagetian level. See Table 2 for ANOVA summaries and Table 3 for means and standard deviations of achievement scores by Piagetian group.

Another series of one-way analysis of variance tests indicated that projects, unit tests, and total achievement differed according to the students' teaching major but quizzes did not. See Table 2 for ANOVA summaries and Table 3 for means and standard deviations of achievement scores by major groups.

Identification of interaction of Piagetian groups and major, as they related to the various types of achievement, was

attempted by utilizing a two-way analysis of variance. However, these interactions could not be identified due to empty cells.

Discussion

The Piagetian scores of this population, 30 percent of whom tested below the formal operations stage of cognitive development, differed according to the students' teacher education major. Secondary majors had significantly higher scores than early childhood, elementary, and K-12 majors. However, none of the majors had means that indicated thought below formal operations. Early childhood majors had the mean closest to the transitional level. This difference in Piagetian level might explain why some students have more difficulty in using higher-order thinking. In regard to the relationship of cognitive level to academic achievement, the results indicated that formal thinkers were significantly different from both concrete and transitional thinkers in the areas of tests and total achievement. Although a one-way analysis of variance resulted in an F ratio significant at the .05 level in the area of projects, a post-hoc analysis utilizing the Scheffé method did not identify significant differences between individual groups. This may be true because the Scheffé method is highly rigorous and/or the variability in the concrete students' achievement was so great that differences were hidden. The differences in the achievement

of students at the various Piagetian cognitive levels would seem to indicate that alternative teaching methods should be used in teaching educational content. Concrete and transitional thinkers undoubtedly need more concrete experiences, such as audiovisuals and field experiences, to help them understand the same concepts that formal thinkers can grasp in the abstract.

In comparing differences in achievement by students with various teaching majors, it was found that K-12 majors were significantly lower than early childhood and elementary majors on projects. They were also significantly different from early childhood and secondary majors on tests and total achievement. A number of factors may be functioning to produce this result. Early childhood majors may have had the highest score in each type of achievement because they perceived the content of developmental psychology as extremely relevant to success in their chosen profession. Secondary majors may have had higher scores than K-12 in tests and total achievement because they had higher Piagetian levels and were therefore able to learn higher-order material (as found in tests) more effectively. Early childhood and elementary majors may have achieved higher scores on projects because it was easier to observe and interpret behavior of young children more accurately than to observe the same behavior in special subjects such as physical education and art. Also, K-12

(special areas) majors may have perceived content in their own major to be more important than they considered the students they plan to teach. Consequently, they did not study as hard for a class in developmental psychology as they did for their specific content courses. Another factor might be that examples of student behavior were easier to identify in elementary and secondary than they were in the special areas included in K-12 certification.

Whatever the reasons for the difference in student achievement, logic seems to indicate that grouping students by major may help them learn more effectively than grouping them in sections where all majors are present. If grouped in this way, perhaps teacher education faculty would be faced with classes which were more homogeneous in terms of thought processes or cognitive level. Then alternative methodologies could be employed to prepare future teachers for their profession in a more effective way.

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Table 1

Means and Standard Deviations of

Piagetian Scores by Major

	$\bar{X}$	SD
Early Childhood (33)	14.06	3.18
Elementary (276)	14.70	3.07
Secondary (188)	16.14*	2.85
K-12 (168)	14.84	3.03

*Secondary group significantly different from early childhood, elementary, and K-12 groups at .05 level (using Scheffé)

Table 2

ANOVA Summary Table for Testing the Significant Differences in Student Achievement with Piagetian Scores and Major

	Quizzes			Projects			Unit Tests			Total Achievement		
Sources of Variation	df	MS	F	df	MS	F	df	MS	F	df	MS	F
Piaget												
Between	2	394.70	11.05***	2	246.99	3.63*	2	9425.88	30.59***	2	21101.13	22.63***
Within	666	35.72		660	68.01		667	308.18		667	932.38	
Major												
Between	3	83.17	2.28	3	339.05	5.18**	3	2279.21	6.97***	3	4692.85	4.83**
Within	662	36.53		656	65.40		663	326.98		663	972.49	

*$p < .05$

**$p < .01$

***$p < .001$

Table 3

Means and Standard Deviations of Achievement Scores

by Piagetian Group and Major

	Quizzes		Projects		Tests		Total	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Piagetian Group								
Concrete	46.89	3.92	44.80	11.31	134.20	11.97	233.80	17.45
Transitional (192)	46.88	6.51	49.02	9.00	143.25	19.63	246.28	34.06
Formal (468)	49.25[a]	5.78	50.33	7.85	154.12[b]	16.72	262.65[c]	29.18
Major								
Early Childhood (33)	50.21	6.59	53.27	5.33	157.00	17.31	268.79	24.02
Elementary (276)	48.58	6.19	50.56	7.59	150.26	18.73	256.81	31.82
Secondary (188)	49.01	5.47	50.12	8.11	154.31	16.53	262.26	29.57
K-12 (168)	47.71	6.30	48.14[d]	9.21	146.46[e]	18.79	251.79[f]	33.05

[a]formal significantly different from transitional at .05 level

[b]formal significantly different from concrete and transitional at .05 level

[c]formal significantly different from concrete and transitional at .05 level

[d]K-12 significantly different from early childhood and elementary at .05 level

[e]K-12 significantly different from early childhood and secondary at .05 level

[f]K-12 significantly different from early childhood and secondary at .05 level